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ABSTRACT

The purpose of this study was to test the effects of an experimental method of instruction upon the cognitive development of disadvantaged first grade children. The hypotheses formulated were: (1) there is no difference between the medians of the control and experimental groups or between the numbers of subjects in each group placing at the various stages of conservation on conservation of substance tasks, conservation of quantity (discontinuous) tasks, and seriation tasks; and (2) there is no difference between the medians of the control and experimental groups on the Numbers subtest of the Metropolitan Readiness Tests. The sample consisted of 38 first grade pupils (mean age 6 years and 3 months at the beginning of the year) primarily from Mexican-American, low income homes. The students were pretested in September. Near the end of the year, a 6-week training program consisting of 30-minute daily lessons using Piaget's tasks was administered to the experimental group by teacher aides. The controls were simultaneously given a traditional arithmetic program. The experimental program emphasized children's manipulation and classification of materials and the development of language and concepts of number, size, weight and length as well as an awareness of reversibility in relation to many different kinds of transformations. Both hypotheses were supported. (Author/AJ)

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A COMPARISON STUDY OF THE COGNITIVE DEVELOPMENT of DISADVANTAGED FIRST GRADE PUPILS (As Measured by Selected Piagetian Tasks)

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INTRODUCTION

The present study is the result of an interest in developing new curriculum materials and methods of instruction for young educationally disadvantaged children. The work of Jean Piaget has been chosen as a basis for this particular endeavor. The purpose of the study was to test the effects of an experimental treatment or method of instruction, using Piaget's tasks (experiments) as criterion measures, upon the cognitive development of disadvantaged first grade youngsters. The hypotheses formulated were as follows:

1) There is no difference between the medians of the control and experimental groups or between the numbers of Ss in each group placing at the various stages of conservation on the following measures:
   a) Conservation of substance tasks
   b) Conservation of quantity (discontinuous) tasks
   c) Seriation tasks
2) There is no difference between the medians of the control and experimental groups on the Numbers sub test from the Metropolitan Readiness Tests.

The Literature: There have been a number of studies within the past ten years which have attempted to standardize the various tasks or experiments of Piaget. Replication studies, which have been the most numerous, have dealt with such topics as conservation of quantity, number concepts, spatial and geometric concepts, and logical operations. Elkind's (1961) findings regarding conservation of quantity (substance, weight, volume) agreed closely with those of Piaget as to the time and sequence of discovery of conservation of quantity. Lovell and Ogilvie (1960), in a study of substance conservation, also agreed with Piaget's findings. Uzgiris (1964) studied the degree to which the ability to conserve in one situation is transferred or generalized to different situations and found

that the appearance of conservation with one set of material does not enable one to predict its appearance with other stimulus material. Reversibility, a key concept in the theory, is deemed by Inhelder (1962) to be a major prerequisite of conservation. Lovell and Ogilvie (1961) questioned this as a result of their finding that a number of the subjects who failed to conserve, did in fact have an awareness of the operation concept.

Conservation of number, according to Piaget (1952), follows a stage sequence and is closely related to the acquisition of the conservation of quantity. It is also linked to the development of logical operations of classification and seriation. Elkind's (1964) study confirmed Piaget's findings that discrimination, seriation, and numeration follow in that order. Wohlwill (1960), using scalogram analysis, also found the stages in the development of the number concept in accord with Piaget. Dodwell (1968) studied the relationship of number concepts to traditional arithmetical abilities and to logical operations, confirming Piaget's contention that children's ability to count does not necessarily mean that children understand number. Dodwell (1968), in another study, disconfirmed Piaget's conclusion that logical classification is both necessary and sufficient for establishing number concepts.

Generally, the replication studies confirmed Piaget's theory regarding stages and stage progression and the fact that children pass through the various stages in invariant sequence but at different times or ages. The lower limits of seven or eight years of age is also borne out as the age when concrete operations appear and when children evidence acquisition of the conservations of substance, numbers, and seriation.

Training studies comprise another segment of the more recent research. It is in these studies that the idea is tested that conservation or logical operations can be accelerated. Piaget regarded the idea of acceleration as a typically American concern but without substance. Almy (1966: 42) confirmed

Piaget's conclusion stating that "Taken as a whole, such attempts have been rather unsuccessful."

However, this has not convinced researchers who have based their methods of training (to accelerate conservation) on such procedures as cognitive conflict and reinforcement (Smedslund 1968), reversibility (Wallach and Sprott 1964), logical prerequisites such as multiple classification, multiple relationality, and reversibility (Sigel, Roeper and Hooper), nonverbal methods (Wohlwill and Lowe 1962), and perceptual training (Beilin, Kagan and Rabinowitz 1966).

Sigel and Hooper (1968: 263), summed up the research involving training, stating "It is evident that no single type of training is equally effective for all kinds of problems." The effectiveness of the training is probably dependent upon the developmental level of the child, the kind or class of problem, and the kind of training technique used, as well as how effectively or appropriately the training was managed.

Piaget (1964) saw the intellectual development of the child through the various stages as the result of four interacting factors: maturation, experience, social transmission, and equilibration. Hunt (1969), Ausubel (1968), and Bloom et al. (1965) have, among others, documented the fact that disadvantaged children have profundly limited experiential backgrounds. This being the case, the possibility of enhancing cognitive development or accelerating progress from one stage of cognitive development to another should be investigated further. It also should be noted that Piaget did not work with children who could be identified as "disadvantaged."

Conservation, a key concept in Piaget's theory, is taken as an index of cognitive development and as an indication that the child has progressed, in some measure, from the preoperational stage to the operational stage.

METHOD

DESIGN

		Pretest (September)		Posttest (May)
(R)	Experimental	T_{1_E}	Traditional program...Experimental treatment...	T_{2_E}
(R)	Control	T_{1_C}	Traditional program.....	T_{2_C}

The Sample: The sample consisted of 38 first grade pupils, primarily of Mexican-American background, from low income or welfare homes. These children were part of a larger group of children (the population) who had been identified as participants in Title I programs in three schools in the Ontario-Montclair School District through criteria set by the U. S. Office of Education. Selection of the subjects was done by randomly assigning those already-identified students in any one classroom to the experimental or control group. The mean age of the sample was 6 years - 3 months at the beginning of the year and 6 years - 11 months at the time of posttesting. There was a month difference between the mean age of the E and the C group and the ages in each group ranged from 5 years-9 months to 7 years-4 months on the pretest and from 6 years-5 months to 8 years on the posttest.

Experimental Treatment: A six-week training program consisting of 30 minute daily lessons was administered near the end of the school year to the E group. Teacher's aides, working under the close supervision of the researcher and an assistant, administered this program. At the same time another set of teacher's aides, also working under close supervision, worked with the controls, giving them the same amount of time but a traditional arithmetic program. Prior to the start of the experimental program both E and C subjects had been receiving the same kind of programs and the same amount of special help.

The training of the experimental program aides consisted of role playing and of learning techniques for teaching lessons designed to actively involve the subjects physically and mentally in such activities as pouring, weighing, balancing, sorting, seriating, measuring, grouping and regrouping, etc. Help was given these aides in asking appropriate questions of the children. The emphasis was on having children manipulate and classify materials and upon developing language and concepts relating to number, size, weight and length as well as developing an awareness of reversibility in relation to many different kinds of transformations.

Aides working with the controls received training and help in administering the traditional arithmetic program, primarily paper and pencil oriented, which was being used in the classrooms in which they worked. Other than the flannel-board, no other concrete materials were included in the training. The aides were chosen to work with either the E or C group on the basis of which group they were working with when the classrooms were randomly assigned. Aides in both E and C programs were judged to be comparable in ability and job performance. Educational level and ethnic background were found to be quite similar.

Criterion Tests: Piaget's three experiments used as criterion measures were chosen because of their relatedness to the content of the experimental program and their appropriateness for children in the age range of the sample used in this study. The subjects were administered the Piagetian tasks individually and scoring was based upon verbal and nonverbal responses of the subjects as they worked with physical materials (clay, dominoes, seriated sticks) used in the experiments. The responses were recorded as stage classifications for two of the experiments and as numerical raw scores for the conservation of quantity and the readiness test.

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RESULTS

Table 1. Conservation of Substance

	Pretest		Posttest	
	E	C	E	C
Number of non-conservers	18	20	16	20
Transitional stage	0	0	2	0
Number of conservers	0	0	0	0

X^2 = (not significant)

Table 2. Conservation of Quantity

	Pretest		Postest	
	E	C	E	C
Above combined median	10	7	10	6
Below combined median	8	9	7	7

X^2 = .117 (pretest) X^2 = .106 (posttest)

Table 3. Seriation of Sticks

		Pretest		Posttest	
		E	C	E	C
Stage I	(number of Ss)	16	15	11	12
Stage II	(number of Ss)	1	4	5	6
Stage III	(number of Ss)	1	1	2	2

X^2 = 2.43 (pretest) X^2 = .02 (posttest)

Table 4. Metropolitan Readiness Tests: Numbers

	Pretest		Posttest	
	E	C	E	C
Above combined median	8	10	9	9
Below combined median	10	10	9	11

X^2 = .013 (pretest) X^2 = .12 (posttest)

No posttest differences were found to be significant (Set at the .05 level) for any measure. Pretest differences, also not significant, indicate the groups to be equivalent at the beginning of the year on the measures used.

DISCUSSION

This study found very few subjects in either the control or the experimental group to be conserving on any one task at an age just short of 7 years. Only slightly more children were found to be at the transitional stage. The majority of subjects in the sample were found to be in Stage I, or not conserving, at the end of their first grade year.

On the Numbers subtest from the Metropolitan the majority of subjects in the sample were at or above the point portrayed in the test manual as indicating average expectation of success in first grade. This was at the end of the year, it must be remembered, and at the beginning of the year no child was at this point.

Research, such as the study by Almy (1966), showed very few first grade children labeled as "disadvantaged" to be conserving over a number of different tasks as contrasted with a considerable number of middle class children. Piaget's theory viewed seven years as that pivotal age between the period of the formation or elaboration of operational thought and the period of structuration following its attainment. In most of Piaget's research, and in the replication studies cited, many children (in some studies, more than half) were found to be conserving by the time they had reached the age of seven.

The fact that there were no significant differences between the medians of the groups or between the numbers of children in either the E or C group who were at the various stages of conservation is not inconsistent with Piaget's theory. However, this finding does not explain so much as it raises further questions. Would there be a difference in the acquisition of conservation if the E group had received this type of program for a full year? Would there be a difference if the E group had been in a program in which much more of the school day was given to interaction with materials in an environment much richer in things to test out and work with? Would the experimental treatment or training program be more likely to have an effect if these children were one year older?

Although the findings do not show the experimental treatment to be superior to the control treatment (or traditional arithmetic program), the rationale for a curriculum based upon active participation of the learner, upon use of materials and the environment, and upon the interaction of the learner with adults and other children in the course of his learning-is still supported. Instrinsic motivation and affective outcomes must be given as much consideration as the appropriateness of the learning situation to the stage of cognitive development of the child.

The final question, posed by this study, is one that is largely ignored by compensatory education programs. If the cognitive development of educationally disadvantaged six and seven-year-olds is still largely at the preoperational stage, how effective are arithmetic (and reading) programs based upon symbolic instruction in developing conceptual understanding and the bases for further learning?

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